Vol. 32, No. 5 May, 1935

THE
PSYCHOLOGICAL BULLETIN

A CRITICAL REVIEW OF EXPERIMENTS ON THE PROBLEM OF STIMULATION DEAFNESS[1]

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The problem of "stimulation deafness" grew out of the search for evidence to prove or refute the "place" theory of pitch reception. If a place theory is tenable, it should be possible to show that the functional presence of a specific part of the auditory receptive mechanism is necessary for the normal reception of a specific narrow range of frequencies. Evidence on this point has accumulated from clinical and experimental investigations of various kinds. Parts of the cochlea have been surgically destroyed and functional tests subsequently made by Gellé, Corradi, Munk (26), Baginsky (1), Marx (24), Andréev (27), Held and Kleinknecht (12), and others, but their results have been considered somewhat inconclusive on account of the possibility that the damages may have been more general or widespread than the experimenters intended. Other investigators have turned to the clinic to see if hearing losses for certain frequencies might be correlated with absence or damage of parts of the receptive mechanism, and recent work by Guild, Crowe, Bunch, and Polvogt (9) has shown rather conclusively that such a correlation exists. In some cases intense tones and noises have been the factors allegedly causal in the production of deafness. It is the studies of these cases of "stimulation deafness" which I shall review in this paper. Those cases in which the stimuli have been noises such as thunder or gunfire will not be included, the review being limited primarily to those investigations in which relatively pure tones have served as stimuli. This literature has previously been

[1] This review was prepared under the direction of Professor Walter S. Hunter.

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reviewed, in German, by Röhr (31) in 1921, by Lange (23) in 1926, and by von Eicken (4) in 1930, but these reviews are neither complete nor generally available. In the present review we shall attempt to determine (A) whether or not breakdown of a definite and limited portion of the cochlea may result from exposure to a high intensity of a specific tone and (B) whether a specific or a general loss of sensitivity may result from such exposure.

Clinical Literature

Otologists have known for many years that smiths, boiler-makers, and locomotive engineers are often hard of hearing for sounds of their working environment. Göttstein and Kaiser (6), Holt (13), Roepke (30), Roosa (32), and Sacher (33) are among those who have reported this fact. Few investigators have gone beyond the functional examination and sought to determine probable causation or underlying pathology. Habermann (10), in 1890, made functional examinations of 25 boiler-makers and found that all of them were hard of hearing, especially for high tones. He carried out a post-mortem examination on the inner ears of 1 patient, an eighty-one-year-old man, and found degeneration of the organ of Corti in the basal turn. In 1906 (11) he presented functional data derived from tests of 107 cases of occupational deafness. Histological examinations of the cochleæ of 5 of these patients (1 boiler-maker, 2 smiths, an artillerist, and an engineer) revealed atrophy of the organ of Corti, located primarily in the basal turn but to some extent in all turns. The fact that such degeneration as Habermann found is rather frequently an accompaniment of increasing age and might have been expected in people of the ages of Habermann's patients has already been pointed out by Wittmaack (41) and others. Popoff (28) states that Brühl and Zange have corroborated Habermann's results.

Ritchie Rodger, in 1915 and in 1923 (29), published further data on "boiler-makers' deafness". He attempted to determine the pitches of predominant noises in the workshops of his subjects by comparison with tuning-forks and concluded that most of them fell between 419 and 512 dv. per sec. Whether these determinations were made before or after his functional examinations cannot be stated. He summarized his results as follows: "It was found that some boys who alleged they were not deaf at all had quite a distinct depreciation for hearing for forks A_1 and C_2 (419 and 512) although there was no loss for low and high notes. No ear examined failed to show depreciation for the medium forks, although, of the men less

than ten years at work, 4 per cent had no depreciation at all for fork 32, and 10 per cent none for 2,048. In this group the upper tone limit was practically unaffected. One examinee could appreciate 20,000 double vibrations although his hearing for medium forks was reduced to ⅔,[2] while three could hear 19,000, with the medium forks reduced to ¾. Only 3 per cent fell below 15,000. In group two, comprising men who had been ten to thirty years at work, there was some depreciation all along the scale, but more marked for the medium forks. It was only in group three, consisting of men over 30 years employed, that all parts of the scale were found to be more or less uniformly affected. In a word, it was found that in the very early cases depreciation had only occurred, but had also always occurred, in that part of the scale corresponding in pitch to the predominant noises of the workshop; in cases which had passed the early stage, depreciation was found in all parts of the scale, but was more marked for the part corresponding to the predominant noises; while in the very advanced cases, the depreciation was uniform" (29, pp. 67–68). No histological examination of the ears of these patients was reported.

Experimental Literature

It was natural that the publication of Habermann's clinical data would be followed by experimentation in which attempts would be made to produce similar lesions in the ears of experimental animals under more rigorously controlled conditions of exposure and examination. Von Stein (36), in 1894, stated that he had been trying for some time to produce pathological changes in the ears of guinea pigs by exposing them to the tones of tuning-forks, but any results which he may have obtained were never reported.

Wittmaack (41), in 1907, published the results of the first extensive study of this kind. He exposed guinea pigs to intense sounds produced by a bell, a whistle, and a rifle, and made histological examinations of the ears of his animals following this treatment. When the sound of a bell was conducted by air to the ears of the animals no damages were found after 5, 10, 20, 30, 40 or 60 days of exposure. When the sound was presented by air-and-bone conduction (by allowing the clapper of the bell to strike against the metal plate on which the animals sat), degeneration of nerve endings

[2] The time during which the examiner continued to hear the sound from a struck tuning-fork was taken as 1. The fraction (⅔, ¾, etc.) refers to the part of this time during which the examinee could hear the sound.

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as well as of cells of the spiral ganglion was found after 5, 10, 14, and 16 days of continuous exposure and after 3, 5, 10, 20, 30, 50, 70, 90, 120, 150, 200, and 240 days of exposure for 12 to 14 hours per day. In another experiment Wittmaack blew a very shrill whistle directly into the auditory meatus "mit voller Lungenkraft" 4 times daily or on alternate days, during periods of 3 to 200 days. He states that these blasts were so terrific that the guinea pigs fell down "bewusstlos, regungslos, und gefühllos". Histological examinations revealed degeneration at the basal end of the cochlea, a degeneration which varied in extent with the duration of exposure. Sometimes no trace of the organ of Corti was left in the affected region. In another experiment he blew into the meatus only once and killed the animals after intervals of a few minutes, 12 hours, or 1, 2, 3, 5, 8, 12, 18, or 25 days. He was able to trace the degeneration and regeneration of the cells and fibers of limited portions of the spiral ganglion and auditory nerve. He expressed the opinion that the first effect of such intense stimulation is neuritis, and that the degeneration of the organ of Corti is a secondary effect. In a second paper (**42**) he stated that sharply circumscribed lesions were produced in the next to the lowest turn of the cochlea of the guinea pig by similar daily blasts of a c_3 pipe for 4 weeks. Wittmaack has frequently restated his opinion that such damages are produced through bone conduction, while a contrary opinion has been expressed by Siebenmann and his students. (For reviews of this controversy see articles by Siebenmann, **35**, von Eicken, **4**, and Wittmaack, **43**.)

Yoshii (**44**), in 1909, published an account of a very complete series of experiments which he had carried out in the laboratory of Siebenmann. Guinea pigs were exposed to tones from Edelmann pipes c_5 and b_2, an organ-pipe G, a siren with a range between c_3 and f_4, and a "Trillerpfeife" f_4. The whistles were blown for 12 hours per day with a constant pressure of 5 mm. Hg and the guinea pigs were kept within 10–12 cm. of the sound source. After exposure to the whistle c_5 for 30, 40, 60, 80, 100 or 120 days the guinea pigs were killed and examined. It was found that the outer and inner hair cells were missing in the middle section of the basal turn, and that the damage varied in extent with the length of the exposure period. Animals of another group were exposed to the b_2 whistle for 30, 40, 60, 80, 100, or 120 days and similar damages were found in the lower part of the second turn of their cochleæ. When the organ-pipe G was used, injury in the upper part of the second turn resulted from exposure for 30 or 40 days. Yoshii stated that the

purity of the tone produced by the G pipe was at times, unfortunately, somewhat disturbed. Animals were subjected once daily for 8, 25, 50, 80, 100, or 130 days to the tone of a siren, the range of which was from about c_3 to f_4. Regions of greatest damage were in the lower portion and the beginning of the upper portion of the second turn. With the "Trillerpfeife" (about f_4, but with a very high overtone) changes were produced in the basal turn down to the lowest end.

Marx (25), in 1909, carried out a similar experiment, in which guinea pigs were exposed to whistles of pitches a_4, a_3, a_2, and e_2 many times a day for 4 weeks. Degenerative changes in the inner ear, consisting of atrophy and shrinkage of the organ of Corti, were produced only with the pitches a_4 and a_3. With a_4 damages were localized exclusively in the 2 lower turns and were greatest in the upper half of the basal turn. With higher intensities of the same tone the damage extended over the lowest one-and-one-half turns. With the a_3 whistle the region of greatest damage was located at the beginning of the second turn. With whistles a_2 and e_2 no histological damages were produced. Marx explained this failure to produce degeneration with the lower tones as due to the lower intensity of those tones or the lack of sensitivity of his animals for them. He believed that the widespread degeneration produced with higher intensities was an argument against the Helmholtz theory. Furthermore, he made use of Preyer's reflex to examine animals in which localized degeneration in both ears had been produced by exposure, and found that not only did they fail to respond to the exposure tone but also failed to respond to any tones.

Marx, according to Röhr (31), later exposed white mice to the same tones with which he had produced degenerative changes in the ears of his guinea pigs and failed to find any damages at all which might have resulted from the exposure. He thought that this failure might have been due to a difference in experimental conditions. He had found it impossible to let the sound fall directly on the ears of the mice, as he had with the guinea pigs, for the mice had been separated from the source of the sound by a wire netting.

According to Röhr (31), von Eicken exposed guinea pigs to the organ-pipe G during 12 hours a day over a period of 6 weeks. His exposure conditions were similar to those of Yoshii. Degeneration was produced except in cases in which the anvil had been removed prior to the exposure. With a C pipe and similar exposure periods no degenerative changes were produced.

Grünberg (7) in 1912 reported an experiment in which he blew

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" mit voller Lungenkraft " into the right meatus of pigeons many times a day for periods of 7 and 14 days. With pipe a_3 degenerated sense cells were found in the second quarter of the inner ear with both 7 and 14 day groups. Similar results were obtained with the group exposed for 7 days to pipe a_4. The results were inconsistent in that no damages were found in a group exposed for 14 days to pipe a_4.

Hössli (14), in 1911–1912, used young guinea pigs as subjects and tested them with Preyer's reflex before the exposure. He says that the results with this reflex were not always definite. Organ-pipes were used as tone sources and they were blown, as in Yoshii's experiment, with a constant pressure of about 5 mm. Hg. The exposure period lasted 10–12 hours per day. Animals were kept 10–12 cm. distant from the exposure tone unless otherwise indicated. Six guinea pigs were exposed to c_5 each day for 10 days and the external hair cells of the upper part of the basal turn were found to be injured. When the pipe g_4 was used and the exposure lasted 32 days, the external hair cells of a slightly higher band of the basal and lower second turns were affected. Four animals were exposed for the usual daily period during 20 days to Galton pipes c_4 and c_6, blown simultaneously. The greatest damage was found in the middle portion of the second turn but some slight changes were observed in the lower part of the basal turn. Since the intensity of the c_4 pipe was greater than that of the c_6, Hössli believed that the upper region had been affected by the former and the lower region by the latter tone. When animals were exposed to b_2 for 3 weeks, followed by c_5 for about 2 more weeks, very slight or doubtful effects were produced in the external hair cells of a few sections of the 2 lower turns.

Of 11 animals who were exposed to c_2 and c_5, blown simultaneously, faulty injection of fixing fluids left only 3 or 4 ears in which any degeneration attributable to sound could be found, and in these the proximal external hair cells of the upper basal turn were affected. Other experiments, in which Hössli used animals other than guinea pigs as subjects, were not so conclusive. An ape was exposed to the tone c_5 at a distance of 30–50 cm. for 10 days and breakdown of the external hair cells in the upper two-fifths of the basal turn resulted. A second ape exposed under similar conditions gave negative results. Another ape was exposed to c_3 and c_6 blown simultaneously for 32 days, and no damages resulted. Two cats were exposed to c_5 at a distance of 10–15 cm. for 19 days and no histological damages resulted in one case, while in the other there

was degeneration of the external hair cells of the lower part of the second turn. Dogs exposed to d_1 and d_4 simultaneously for 6 weeks showed external hair cells broken down in the upper first and lower second turns. Other dogs exposed to e_4 for 21 days, followed by e_1 for 33 days, gave only doubtful or completely negative results. Largely on the basis of his results with guinea pigs Hössli concluded that degeneration in the inner ear results from prolonged exposure to intense tones and " dass der Defekt umso eher eintritt und umsogrösser wird, je intensiver und höher der Ton ist " (**14**, p. 133).

Kato (**18**), in 1913, found that cutting the middle ear muscles in birds decreased the time necessary for the production of deafness through intense tonal stimulation. Absence of Preyer's reflex was regarded as evidence for deafness.

Satch (**34**), in 1917, exposed pigeons, starlings, and parrots to sounds from organ-pipes c_5, c_3, and c_1, blown with constant pressure of 5 mm. Hg., for 12 hours a day during 10, 20, 30, 40 or 50 days. Not a trace of an effect was found in any of his animals.

Röhr (**31**) exposed guinea pigs to the tones C, c_0, c_1, c_2, c_3, c_4, c_5, and c_6. The sounds were produced directly in the external meatus of one ear and resulting damages were found only in that ear. With c_0 the external hair cells of the highest turn were broken down, while with c_1 and c_2 there was breakdown of the organ of Corti and atrophy of the nerve over a wide band, with degeneration of some fibers of the otic ganglion in the third turn. With C, c_3, c_4, c_5, and c_6 absolutely no degeneration was obtained. The fact that the changes produced in one ear were contrasted with the normal condition of the contralateral unaffected ear made the few positive results particularly valuable.

Röhr (**31**) also exposed white mice under conditions similar to those which he had found satisfactory with guinea pigs. The sounds were delivered directly into the auditory meatus of the mice through a glass funnel and the animals were mechanically held in position, but he, like Marx, failed to find any histological damage in the ears of the mice at the end of the exposure.

Kimura (**20**), in research directed by Wittmaack, used a carbonic acid bomb to provide pressure for blowing a c_3 whistle twice daily for about 1 minute directly into the external meatus of guinea pigs, white mice, and pigeons. In white mice, after 2 weeks of such treatment, the sense cells of the organ of Corti were found degenerated in the region between the 2 lowest turns of the cochlea. After 4 or 6 weeks the organ of Corti was completely missing in part of this

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TABLE I

A Summary of Experiments on Guinea Pigs

Name	Conditions of Exposure			Anatomical Lesion
	Tone	Intensity, Etc.*	Duration	
Wittmaack 1907	Bell	(By air cond.)	5–60 days	No effect
	"	(By bone cond.)	5–16 "	Atrophy organ of Corti and VIIIth nerve
	"	" " "	3–240 days x 12 hours	
	Whistle	"voller Lungenkraft"	3–200 " 4 times per day	Basal degeneration of nerve and organ of Corti
	"	" "	Once only	" " " " " "
	c_3	" "	Once daily x 28 days	Degeneration of nerve and organ of Corti, second turn
Yoshii 1909	c_5	5 mm. Hg. pressure	30–120 days x 12 hrs.	Ext. and int. hair cells of middle basal turn
	b_2	4–5 mm. Hg.	" " " " "	Same in lower second turn
	G	" " "	30–40 " " " "	" " upper " "
	Siren, c_3 to f_4	" " "	Once daily x 8–130 days	Same in lower and upper second turns
	Trill f_4	" " "		Same in basal down to end
Marx 1909	a_4		28 days x ? hrs.	Hair cells in upper basal turn
	a_3		" " " " "	" " " lower " "
	a_2		" " " " "	No effect
	e_3		" " " " "	" "
von Eicken	G		42 days x 12 hrs.	Degeneration
	G	(Anvil removed)	" " " " "	No effect
	C		" " " " "	" "

* This column contains information concerning exposure conditions which might affect intensity.

TABLE I—*Continued*

Name	Conditions of Exposure			Anatomical Lesion
	Tone	Intensity, Etc.	Duration	
Hössli 1911–12	c_5	5 mm. Hg.	10 days x 10–12 hrs.	Ext. hair cells upper basal turn
	g_4	" " "	32 " " " "	" " " " " and lower 2nd
	c_4 and c_6	" " "	20 " " " "	" " " lower " " middle "
	b_5 followed by c_6	" " "	21 (+14) days x 10–12 hrs.	" " " two lower turns
	c_3 and c_5	" " "		Proximal ext. hair cells upper basal turn
Röhr 1921	c	(All directly in meatus)		No effect
	c_0			Ext. hair cells highest turn
	c_1			Organ of Corti 3rd turn
	c_2			" " " " "
	c_3			No effect
	c_4			" "
	c_5			" "
	c_6			" "
Kimura 1924	c_3	Blown by carbonic acid bomb	2–6 weeks (2 min. daily)	Organ of Corti between 2 lowest turns

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TABLE II

EXPERIMENTS ON ANIMALS OTHER THAN GUINEA PIGS

Name	Animal	Conditions of Exposure			Locus of Anatomical Lesions
		Pitch	Intensity, Etc.	Duration	
Marx 1909	Mice	Like guinea pigs except for wire			No effects
Grünberg 1912	Pigeons	a_3	" voller Lungen-kraft"	7 days	2nd quarter
		a_3		14 "	" "
		a_4		7 "	" "
		a_4		14 "	No effects
Hössli 1912	Apes	c_5	5 mm. Hg.	10 days x 10–12 hrs.	Ext. hair cells upper basal turn
		c_5	" " "	" " " "	No effects
		c_3 and c_8	" " "	32 " " "	" "
	Cats	c_5	" " "	19 " " "	Ext. hair cells lower second turn
		c_5	" " "	19 " " "	No effects
	Dogs	d_1 and d_4	" " "	42 " " "	Upper first and lower second turn
		c_4 followed by e_1	" " "	21 " " "	No effects
				33 " " "	
Satch 1917	Pigeons	c_3	5 mm. Hg.	10–50 days x 12 hrs.	No effects
	Starlings	c_3	" " "	" " " "	" "
	& Parrots	c_1	" " "	" " " "	" "
Röhr, 1921	Mice	As with guinea pigs			No effects
Wada 1924	Pigeons	With tensor tympani normal		60–71 hours	No effects
		With tensor tympani cut		61–63 "	" "
Kimura 1924	Mice	c_2	H_2CO_3 bomb	2 min. daily, 2–6 weeks	Organ of Corti degeneration between two lowest turns
	Pigeons	c_2	" "	2 " " 2–3 "	Degen. part of papilla basilaris

region. Similar changes were produced in a control group of guinea pigs. Two or 3 weeks of this treatment resulted in complete atrophy of a portion of the papilla basilaris in pigeons. Kimura believed that the negative results obtained by earlier authors with exposure of white mice and pigeons could be attributed to the inadequacy of their exposure methods.

Kimura (**20**) states that Klett (**21**) secured positive results in pigeons by somewhat similar methods, but the dissertation of the latter is not accessible to this reviewer. Wada (**39**), in 1924, reported that he exposed birds for periods of 60 or 71 hours with the M. tympani normal, and for 61 or 63 hours with the M. tympani cut, and found no histological or functional damage in either case. Several experimenters, among them Körner and Grünberg (**8, 22**), have exposed amphibia and fishes to intense sounds with negative results. Popoff's experiments (**28**), reported in 1927, in which he obtained degeneration in the inner ears of mice by exposing them to intense factory sounds, are hardly comparable to these experiments in which relatively pure tones have been employed.

Tables I and II summarize all the German experiments.

Boring (**2**), in 1926, suggested the possibility that the degeneration produced by a tone might depend for its locus upon the amplitude of the tone used, since more intense tones would, according to a telephone theory, disturb relatively larger parts of the basilar membrane and degeneration might occur at the point where the moving region joins the quiescent region. The question of whether the degeneration had been accompanied by specific losses for narrow ranges of frequencies or for certain intensities, regardless of frequency, might have been answered if the early investigators had made adequate hearing tests before and after the exposure of their animals. In most cases, however, such tests were not made, and in those cases where tests were made, Preyer's reflex was taken as a criterion. Even investigators who made use of this reflex pointed out its lack of reliability.

In an effort to provide accurate data on the hearing of guinea pigs before and after exposure to intense tones, Upton (**37, 38**), in 1929, carried out an experiment in which a respiratory reflex method was used to determine the auditory sensitivity of guinea pigs. The respiratory response to electric shock was conditioned to a low intensity of a 600-cycle tone. This tone was obtained from a loud speaker connected to a General Radio 213 Audio-Oscillator (tuning-fork microphone—button type) driven by 5.2 volts from a storage

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battery. The secondary coil of the output transformer of this oscillator is equipped with 4 terminals. The first is a common lead while the other 3 provide 3 separate intensities. Four animals were conditioned to respond to the lowest of the 3 intensities. Since all of them were conditioned to the lowest intensity available, we have no information concerning their limen for 600 cycles other than the fact that it was at least as low as the lowest intensity available with the apparatus used. At the end of this preliminary conditioning these 4 animals and 4 other untrained and untested animals were exposed to the highest available intensity of the 600-cycle tone for a period of 70 days and nights. During this exposure period the animals were kept in 2 cages, which were placed 2 feet and 8 feet, respectively, from the center of the loud speaker. Two tested and 2 untested animals were kept in the near cage and 2 tested and 6 untested animals, in the far cage.

As soon as the exposure period was terminated, all of these animals and 4 others who had not been exposed were tested for "direct response" to the 3 available intensities of the 600-cycle tone and of a 1,000-cycle tone produced by a similar oscillator. Since these animals were apparently tested for "direct response" without preliminary reconditioning or simultaneous reinforcement, it appears probable that Upton was really using the unconditioned startle reflex to sound, for it seems improbable that the conditioned reflex would have been retained throughout non-reinforced exposure. Upton concluded, on the basis of these tests, that the limen for 600 cycles for the near-cage group was "far above the highest intensity obtainable with a 24-inch separation between the animal and the source of the tone" while the intensity limen for the control group fell somewhere between the 2 lower intensities of the 600-cycle tone. The far-cage group gave responses to all intensities of the 600-cycle tone, indicating, according to Upton, an increase of sensitivity to the exposure frequency. Animals of all groups responded to the highest intensity, some animals responded to the medium intensity, and no animals responded to the lowest intensity of the 1,000-cycle tone. An attempt to recondition the 2 animals from the near-cage group, which had failed to respond to any intensity of the exposure tone, to the lowest intensity of this tone, was unsuccessful after 3 times as many trials as had been necessary for original conditioning of these animals to this tone.

From these results Upton concluded: "There is a total loss of sensitivity to tones of the exposure frequency within a very wide

range of intensities. A low degree of sensitivity to very high intensities of the exposure frequency remains after the period of exposure. . . . Exposure to an intense tone does not apparently affect the sensitivity of the exposed animals to other frequencies. . . . The facts established by the experiment support a place-pitch or resonance theory of the perception of sound which regards the cochlea as the organ of pitch discrimination" (38, pp. 409–410).

It seems to the reviewer that these important conclusions are insufficiently justified by the experimental results. In the first place, the non-reinforced "startle reflex" is probably as uncertain and inadequate a criterion of auditory sensitivity as is Preyer's reflex. In the second place, failure to obtain reconditioning to the lowest intensity of the 600-cycle tone may have indicated that the sensitivity of those animals which had previously been conditioned to that intensity had decreased just enough that they could no longer hear that intensity. Since no attempts were made to recondition these animals to the medium or high intensity of the exposure tone, we have no reliable information concerning their limens for that tone after exposure. It is possible that the decrease in sensitivity for the exposure tone may have been very slight. Moreover, since the original conditioning required from 260 to 561 trials, it may be that the method employed was inadequate. Lack of precise information of the conditioned reflex type concerning the limens for the 1,000-cycle tone before and after the exposure makes it impossible for us to determine whether or not a decrease in sensitivity for that tone may not also have taken place. Finally, in regard to the third conclusion, these results hardly support any theory of function of the cochlea, since failure of the animal to respond to a tone after conditioning is not sufficient evidence for one to conclude that the peripheral receptive mechanism had been destroyed or damaged; nor had results of histological examinations following such exposure by earlier experimenters been sufficiently consistent to justify an assumption that degeneration had taken place.

Wever, Bray, and Horton (40) have reported results from a study of auditory nerve responses in the cat after stimulation with (A) a Galton whistle tone of 3,350 cycles during 15 hours per day for 10 days, or (B) the same tone 15 hours per day for 25 days, or (C) a tone of 980 cycles continuously for 45 days. The intensities of the tones were estimated as 80–90 db. above the human threshold. At the end of the stimulation period the animals were prepared and tested for thresholds by the "Wever-Bray" technique. The results

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showed no significant variation from those obtained with control animals.

Finch and Culler (5) were simultaneously engaged in carrying out an experiment in which the auditory acuity of dogs was tested before and after exposure to intense tones. In the first experiment 1 dog, previously tested by a method involving conditioned leg-withdrawal, was exposed to a 1,000-cycle tone for 18 hours and showed an "almost horizontal subsidence" in auditory acuity over a range between 200 and 5,000 cycles. When further exposed for 15 hours to the same tone interrupted 52 times per minute, hearing was further reduced by 30 db., where it remained during the rest of 148 hours of stimulation. In a second experiment another dog was exposed under complete general Nembutal anaesthesia to an interrupted 3,000-cycle tone and tested after each of 5 successive ten-hour exposure periods. Progressive general loss of sensitivity, finally reaching about 70 db. in extent, was found for tones between 500 and 5,000 dv., and no signs of recovery were shown to have taken place when tests were made 31 days after exposure.

Horton[8] (16) has carried out a series of experiments in which animals have first been thoroughly conditioned to each of the 8 octave-tones between 64 and 8,192 cycles per sec., tested for limits of sensitivity to these tones by the use of both descending and ascending series of intensities, exposed for various durations to tones of different frequencies and intensities, and retested during and at various intervals after the exposure period. In the first experiment guinea pigs which had previously been conditioned and tested were exposed for 10 hours daily during 11 days to a 1,000-cycle tone of an intensity approximately 125 db. above the human threshold. They were retested for response to a tone of 1,024 cycles from the third to the fourteenth day after the beginning of the exposure period. At the end of the exposure period and at successive intervals (34, 49, 165, and 298 days) afterward, the animals were retested for sensitivity to all the octave-tones with which they had been tested before exposure. He found that a small general loss of sensitivity to all tones between 64 and 8,192 dv. had occurred during the exposure period and this loss was still apparent after 298 days.

Horton (17), in a second series of experiments, exposed one group of 8 guinea pigs for 2,000 hours to a tone of 1,500 cycles per

[8] I wish to express here my thanks to Dr. George P. Horton, of the University of Washington, for his kindness in allowing me to read the manuscripts of his articles which have not yet appeared in print.

sec. at approximately 100 db. above the human threshold, and another group of 4 guinea pigs for 1,250 hours to a tone of 3,000 cycles at approximately the same intensity. The auditory sensitivity of each animal was determined before and after exposure by the conditioned respiratory response method used in the previous experiment. He states that he found "a general loss of sensitivity to all tones" and says that the loss "was no more confined to one tone than to another".

Kemp (19) has performed 2 experiments on this problem. In the first experiment, limens were determined for 9 guinea pigs by the conditioned respiratory reflex method, for tones of 400, 500, 600, 700, and 800 cycles before and after 70 days of continuous exposure to a 600-cycle tone approximately 65 db. above the human threshold. The 600-cycle exposure tone and short range of test tones were chosen in order to test the possibility that some such central change as experimental extinction might have been responsible for the apparent decrease in sensitivity which Upton had found. Such a change might be greater for the exposure tone than for neighboring tones and should disappear with reconditioning. Tests immediately after removal from the exposure room showed large losses (about 30 db.) for the exposure tone in 3 out of 9 animals with smaller losses for neighboring tones. Within 3 weeks of reconditioning 2 of these 3 animals had recovered practically normal sensitivity and the third, when examined electrophysiologically and histologically by Davis and Lurie (3), was found to have normally sensitive and histologically sound peripheral receptors. In the second experiment guinea pigs were exposed for 75 days to a 600-cycle tone approximately 95 db. above the human threshold and tests over the same short range (from 400 to 800 cycles) revealed a general and uniform loss of about 18 db. Examination of 2 of these animals by Dr. Davis showed small decreases of sensitivity of the peripheral receptor.

In a general attack on the problem of stimulation deafness by behavioral, electrical recording, and histological methods, Davis, Derbyshire, Kemp, Lurie, and Upton (3) have found greater efficiency of high than of low tones in producing decreases of sensitivity of the inner ear mechanism. Lesions of the inner ear, corresponding to tonal gaps revealed in the electrical recording tests, have been found. However, these lesions do not seem to correspond in location to the "place" theoretically affected by the exposure tone; rather, the lesions have always been found in the region of greatest sensitivity, which is stimulated by frequencies of from 1,000 to 2,000 cycles.

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SUMMARY

The foregoing facts may be summarized as follows:

1. People who work in extremely noisy environments are often found to be hard of hearing, particularly for high frequencies. One investigator has reported deafness for certain low frequencies in people who were working in an environment where, it is said, these low tones were predominant. (In all such cases, the relationship between age and hearing defect needs to be considered.)

2. Guinea pigs, exposed for a considerable time to tones of high intensity, have frequently been found to possess cochlear lesions. Such lesions have been produced in several instances where the stimuli have been tones of high frequency, but it is not certain that low tones are similarly effective.

3. Results with exposure of other animals are not conclusive; but there is evidence that sufficiently intense and prolonged stimuli will produce cochlear lesions in white mice and pigeons, and possibly in cats, dogs, and apes.

4. Behavioral examinations before and after such intense and prolonged exposure have usually revealed general rather than specific losses of sensitivity. In one instance with less intense stimulation, behavioral tests have revealed specific losses of sensitivity which were not accompanied by peripheral loss of function or histological breakdown in the cochlea.

5. Electrophysiological examinations after exposure have revealed functional losses which are greatest for frequencies between 1,000 and 2,000, when the frequency of the exposure tone is 2,400 or 2,500 cycles per sec.

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RECENT RESEARCH ON SEX DIFFERENCES

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In 1903, Woolley (**118**) maintained that sex alone does not produce any clear mental differences, and that variations in social training are probably the vital factors in causing obtained mental sex differences. More recent psychological data and opinion do not offer any radical challenge to this point of view. One reason why traditional attitudes still persist, nourished by the facile quotation of one author by another, may be the fact that the extensive literature of the past thirty-five years has been so frequently summarized (**1, 2, 41, 79, 80, 81, 105**).

Biological Research

Advances in endocrinology are promising (**4, 39, 70, 112**). The synthetic manufacture of the ovarian principle, "tri-hydroxy-oestrin", has been reported and discussed (**18**). Recent studies on intersexuality, particularly that of Marañón (**76**), demand a redefinition of the terms "male" and "female", for "in proportion as study in sexual biology has advanced, it has been demonstrated every day more clearly that there is scarcely any human being whose sex is not tainted by a doubt". The evidence for such a statement is largely clinical, as is seen in the true case of a Danish painter who accidentally discovered a female *alter ego* which he developed and finally made by surgical and endocrine operation into a legally recognized functional female (**58**). Books on the anatomy and physiology of sex are rapidly "coming of age". A noted gynecologist (**33**) has enriched his *Human Sex Anatomy* with sketches done by himself in his clinic as a supplement to careful notes. Physiological data are inclined to be more academic (**77**), save for popular theses (**107**). Three books (**45, 94, 108**) indicate the interest in the phylogenetic development of sexuality, and although intended for popular consumption do not sacrifice scientific value.

Several studies which report small sex differences in a wide variety of fields are noted. The sexes are said to differ slightly in growth and nutrition (**40**), in skeletal maturity (**111**), and in the ability to endure pain (**63**). Other studies indicate the relation

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of physiological maturity to character traits (68), the effects of coitus (85) and of vasectomy (90) on female health and sex life. To these must be added two recent books which use biological research to support a compromise attitude by organized religion toward contraception (67, 89).

Motor Development

Past summaries have generally agreed that boys are superior in motor learning, a fact that is somewhat discounted by the more rapid rate of improvement shown by girls. The opposing opinion is supported by the observation of the small number of cases, the absence of uniform test situations, and the smallness of the discovered differences below school age which in some instances favor the girls (as in general motility, age of first sitting alone, walking, being able to button clothes, etc.). Their thesis is that motor development is more a matter of opportunity for practice than of inherent sexuality. Similarly the claim of greater male variability is damaged by the fact that the findings are upset when other tests are used, when subjects are chosen differently, or when a different index of variability is adopted (79). McGeoch (72) has pointed out the smallness of existing differences; recently three studies have reported *no* significant sex differences in motor development (25, 61, 121). Only in animal research is it agreed that sex is a disturbing factor, *per se,* as in controlled experimentation with rats in maze solution (29, 74). It is generally admitted that boys master skilled reactions faster, but in practically every case factors other than biological sex are involved. In learning to walk a tight-wire, for example, the fear emotion is critical (62). Other studies stress age (66). The right of girls to compete in athletics (103) is sharply challenged in our country as opposed to attitudes in modern Russia, Germany, Italy, and the Far East. Biological fact is often still unknown; in some matters the social tradition completely obscures whatever biological differences may eventually be shown to exist.

Language Development and Memory

These two topics are grouped together because of their close relationship in many of our mental tests (15, 28, 59). Various experimenters have found that girls speak their first word earlier (79), have larger vocabularies from cradle to college (36), dominate conversation in mixed groups (106), and also generally retain learned material better (105). It is worthy of note that an objectively measured sample of one-year-old children below the

language level, tested by the delayed reaction technique for simple retention, showed no consistent sex difference (3). It is true that boys make definite gains when test material follows along their socially determined vocational interests (21) and declared values (19, 51). Woolley's suggestion that girls form associations or "higher units" more quickly and easily has recently been confirmed by Harter (50). This is made definite by the use of better testing techniques, such as quadruple choice instead of simple free association (84).

Adaptive Behavior

The definite female superiority in intellectual performance during infancy and the early school years diminishes somewhat in the later school years as the number of uncontrolled variables increases. It is claimed that tests favor girls at the younger years, especially the Binet test, in which memory and verbal material is stressed (15). Such weighting in favor of girls, if it proves to be a fact, is declared to be entirely proper *if* the scale measures the whole of intelligence and not just some selected phase (105). Boys who graduate from high school are probably more highly selected and thus their scores are properly higher than those of girls at this time. Past summaries have puzzled over Terman's findings that the ratio of 116 boys for every 100 girls judged to be potentially very superior shifted to 212 for every 100 at the high school ages (79). Equally complex is the argument over the alleged greater variability of boys as it has been discussed by Ellis and Hollingworth and more recent writers (52, 105). The complexity of the problem is matched by the diversity of attack upon it. A preliminary report of an attempted factor analysis of each sex and age group for several mental abilities has indicated the direction and extent of sex differences for each test at each level (16). Tests are for the 9, 12, and 15 year age levels, thus giving a good sample and a wide range of grades, with 250 subjects in each group equally divided between the sexes. This is a promising form of genetic study of memory organization and its relation to various forms of adaptive mental ability. A biological explanation, in terms of a sex-linked genetic factor of higher incidence of cerebral vulnerability of male fetuses, has been suggested (96) for the slightly better distribution of female intelligence test scores.

Personal-Social Behavior

By far the greatest bulk of references fall into this category, for sex differences are social phenomena whether their origin be in

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heredity or in the social milieu. It is stated that adolescence in particular is a time when such differences stand out and become exaggerated (26a). The complex socialization of biological phenomena has been less carefully and extensively studied than their social manifestations.

Of the many books detailing the history and social position of woman, nine are here listed for reference (9, 53, 65, 75, 83, 88, 98, 113, 116). Recently Halle (47) has reported on the women in Russia, and Puckett (92) on women in new Germany, while Mrs. Roosevelt (95) analyzes the status of our own American women. Halle states that ". . . love is the central inner experience with the majority of Russian women, as with women the world over; because with all their external masculinity, they are inwardly thoroughly womanly, very emotionally disposed. And in spite of all the objectivity which is taking possession of Russian youth, it is just here that the greatest discrepancy between the sexes appears." Halle ranks the women above the men as being stronger, more active and energetic, and more purposeful. The attempts to abolish prostitution have had a real influence on the psychology of Russian women. The influence of dress on femininity has been discussed from three different points of view (56, 60, 119) in which the only common factor is the tracing of the thread back into history. One new book challenges the tradition that women lack a sense of humor (14). Others tell of years of work with delinquent women (43, 115). We have, then, plenty of data as to woman's status. We know her legal status in each of our 48 states (82); we read of her political, social, and economic activities since 1900 (13); we learn of the aims and problems of a projected "scientific psychology" of women (8); we know her opportunities to work at less wages and salaries, and with less assurance that it is worth while after all (6, 54, 69, 99, 117); and we have tabulated her professional activity when she is a psychologist (37).

What about sex differences in emotionality (71)? Conklin indicates the many ways in which we may interpret the word "emotionality" (26a). Is there a greater frequency of emotional response, based upon autonomic and glandular development rather than skeletal? Have women less inhibiting control, less cortical control over the thalamus? Does a woman show her emotions more overtly, and if so, is it a true sex difference or only what she has learned to display because of social tradition? Data exist to show that her testimony is less free from suggestion. Is she more keenly sensitive

to situations that produce emotions? Are there typical male and female emotions in a mutually exclusive sense, or are there typical male and female reactions to the same emotional situation? In addition to this analysis, data are offered to support the traditional belief that men may have an emotional periodicity comparable to that of women (12). This suggests the recent popular thesis that the time when prostate troubles beset man is analogous to the female menopause, especially in its emotional aspects (107). Women are found not to be more susceptible to hypnosis than men (32); they are found to remember pleasant things longer and forget more of the unpleasant (78); they score about the same as men on the Thurstone neurotic inventory (104) and a modified Pressey X-O test (38).

The psychoanalytic approach shows differences to be due to the manner of the forming of the Ego, the Super-ego, and character traits generally, and to the reactions of the female to the "castration complex". The speculations on our idealization of womanhood as especially noted in lyrics (55) or in the brother-sister relationships (17) are contrasted with statistical studies such as that which analyzes the sex life of 1,500 peasant women (44). The majority of the literature deals with the development of inferiority feelings in woman when she discovers her lack of a male penis and rationalizes her lack as punishment for her guilty thoughts. This generally agreed upon theory (11, 27, 30) has been reduced to a complex formula (93) which is:

> "Anatomical experience → extinction of amorphous genital phase of Ego → genital masochism dominates Ego ⇄ defense reaction of Ego; a phallic complementation → fear of castration in Ego."

The various forms of possible defense measures are discussed. It is natural to find psychoanalysts reporting patients who interpret menstruation as proof of sexuality, punishment for masturbation (57), and to regard it as evidence for their sadistic theory of coitus (100). Chadwick (22, 23, 24) has changed from an orthodox form of study to a definitely analytic point of view. The psychiatric importance of menstrual disorders is reviewed in a study of 100 cases in which the authors conclude that the disorders are somewhat characteristic of the different types of personality disorder (5). Finally, it is important to note the lack of agreement on the effect of the menses on various functions as adequately summarized by Seward (102).

Freud (42) gives an authoritative criticism of all previously published psychoanalytic literature on the subject. The essential sex

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differences, according to Freud, are traced to the fact that boys do not have to give up the established genital zone (penis) or mother love-object, while girls must change the genital zone (clitoris) to the vagina and the love-object (mother) to the father. This difficult double transition leads in predisposed subjects to hysteria or paranoid trends. Women may revolt against their sex when forced to admit their "castration" or they may turn to "homosexual" or mannish ways and so cling to the male preference, or they may accept their femininity and make the changes necessary for normal adjustment. Two criticisms of this elaborate theory have recently appeared. Hahn-Kende (**46**) cites clinical and anatomical data to deny the Freudian theory that the clitoris is analogous to the penis. To this the Freudians reply that the two organs have been *thought of* as identical. The other criticism, by Besterman (**10**), explains the "sex war" on a basis of man's fear of women which leads to elaborate and effective taboos enforced by the males for their own protection. The Jungian point of view is stated by Harding (**49**), and that of Adler by Knopf (**64**).

Many studies of the sexual function as manifested in superior subjects have been made, such as the questionnaire studies of Peck and Wells (**86, 87**), Davis (**31**), and the improved analysis by Hamilton (**48**) of 200 college graduates, including many married couples. More recently, Dickinson (**34**) has published data which correlate anatomy and sex behavior in "a thousand marriages" and also 350 cases of unmarried women (**35**). Female hyper-individualism is seen in the struggle against the husband on the one hand and against the self on the other, with the latter being the more difficult and persistent.

Summary and Conclusions

Progress during the past 35 years of research has been chiefly in securing better formulations of the problems, with less dogmatism of biased opinion and better insight into the complex uncontrolled variables involved. Two errors have been made: statements of others have been accepted and repeated as if they were proven fact, and the same experiments have been endlessly repeated without regard for the importance of the problems, the suitability of the methodology, or the sample of subjects tested. The recent tendency to carry on extensive and coördinated projects in organized research centers rather than by isolated individual tests of some small detail is a hopeful corrective of this latter situation. As large research

centers map out carefully conceived and specifically oriented programs, the data will become increasingly definitive.

In conclusion, the following brief statements seem to cover the present status of knowledge of sex differences:

1. All true sex differences are fundamentally biological. They are inadequately understood and are quickly submerged by the psychological reactions with which they are associated.

2. Social environments for males and females are not and never have been the same or equal, a fact which accounts for many differences in vocational interests and choice, preferences and values, and opportunity for practice and achievement. Past studies have stressed the social genesis of sex differences, either because of lack of knowledge of human biology or refusal to study known data. Two divergent lines of thought as to human sexuality, the biological, and the clinical and psychoanalytic, are still in the elementary stage of knowledge. Both need improved methodologies and better validation of obtained data.

3. Mental sex differences are small, and usually a large test sample reveals individual differences within either group greater than inter-group differences.

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THE EFFECT OF DIET ON INTELLIGENCE AND LEARNING *

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Belief in a close association between the state of nutrition and mental capacity does not seem to spring wholly from popular sources. Blanton (7) writes that "school physicians often claim that children are feebleminded because of poor food and malnutrition resulting therefrom", but he himself is inclined to doubt this. Holt (22) expresses his belief that mental development and progress depend upon nutrition although he states that "there is not yet a great deal of reliable data available upon the relation of nutrition to schoolwork". Levine's (26) conviction is that "malnutrition spares nothing, for even the emotional and mental life of the individual may suffer". Even so prominent an authority as E. V. McCollum (27) has given his opinion that "American children cannot subsist upon a diet no better than that of the coolie without increasing the incidence of tuberculosis, dulling their mental capacity and warping their personalities". Karl Pearson (14) is quoted to the effect that "health and intelligence are correlated, although not very markedly". Since health is at times a function of diet, we may infer a slight relationship between diet and intelligence. However, Paterson's (36) critical review would seem to show that we are without definite evidence that health and intelligence are related, except in certain non-nutritional diseases involving the nervous system.

Contrary to what might be expected, an examination of the experimental evidence shows very little to support the belief that intelligence is markedly altered by diet. By intelligence we mean the complex functions measured by a so-called intelligence test. Capacity to learn is considered only one of these functions and is treated separately because of the animal experiments. Blanton (7), after an extended study of malnourished children in the immediate war area of Germany, came to the conclusion that very few had suffered any permanent impairment of intelligence, although lack of energy and marked susceptibility to fatigue were noticeable. He writes that "not more than five per cent of the total school population have

* Read before the Section on Psychology, Iowa Academy of Science, Drake University, April 21, 1934.

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suffered injury to the nervous system such as to affect the intelligence permanently". We may very well doubt whether it was definitely known that an "injury to the nervous system" had occurred or that the effects upon intelligence were permanent. At least, no direct experimental evidence on these points was presented. It probably is significant that in spite of "malnutrition of an extreme degree extending over three years", the distribution of mental capacity was very much the same as would be expected under normal conditions. Blanton also noted no definite increase in the number of children suffering from neuroses and psychoses.

Dowd (12) reports that "undernourished children distribute themselves in tests of intelligence similarly to normal children". He concludes, on the basis of retests following nutritional attention, that "the mental level is not affected, for while improvement was shown in all other respects the I.Q. remained substantially the same".

Smith and Field (40) compared an experimental group of 25 children who were 7% or more underweight according to the Baldwin-Wood tables, with a group of 36 so-called normals. The experimental group was given health talks, daily health lessons, and school lunches. In addition to this, food record sheets were kept, a health chart placed in the room, and gold stars awarded for keeping all the rules. The National Intelligence Test was administered in December and a second form of the same test in May. During that period the gain in weight by the experimental group was 26% above normal expectancy, while the normal group made the expected gain. This finding in weight was not paralleled by results in the intelligence test. In fact, the control group gained more than twice as much as the experimental. Taking the figures as they stand, it might be inferred that nutritional care actually has an adverse effect upon intelligence! However, since no data on statistical reliability are given, caution is advisable and we can only say that a relation between intelligence and nutritional care seems doubtful. The authors suggest that mental gains may be made more slowly than physical and therefore would not be detected in the interval from December to May. This may be true but, of course, remains to be experimentally verified.

Graper and Park (19) report marked gains in intelligence through improved feeding in 8 undernourished children with rather low I.Q.'s (Stanford-Binet), coming from poor homes where apparently there was ignorance concerning nutrition. They conclude that "a great deal can be done by proper feeding to improve the mental and physical conditions of children who are below normal". A critical

analysis of their study makes it doubtful that intellectual capacity was improved through diet. We are not here concerned with the physical effects. There were only 8 subjects and the question of statistical reliability was not considered. Since there was no control group, we are left without information on the effect of practice in taking the intelligence test. The qualifications of those giving the tests were not stated nor was the question of bias given any attention. It is to be strongly suspected that motivation due to special attention played a part, but this is not referred to. In the face of these criticisms it is difficult to believe that we have here a clear-cut demonstration that diet, in and of itself, is capable of causing a marked improvement in intelligence.

Rosenberg (**38**) selected 2 groups each containing 25 underweight children. One group was given a dietary consisting of 1 quart milk, nuts, whole grain cereal, fresh fruits, and fresh vegetables, but without meat or eggs. The other group was given a "representative American dietary". The experiment was continued for a period of 6 months. The gain in I.Q. (Stanford-Binet) for the 2 groups was .83 and .60, respectively. This difference of less than a point is probably not significant, although again we are in doubt as to how much confidence may be placed in the results due to the absence of figures on statistical reliability. The evidence would seem to indicate that the I.Q. was not influenced by diet.

In an experiment by Nicholls (**35**), 59 children, 9% or more underweight, were compared with children of the same sex, chronological age, and intelligence test score but of normal height-weight. No difference was found on the opposites test, memory span for digits, attention test (number work), and the motor coördination test. It will be noted that the first 3 are similar to those sometimes used in tests of intelligence. The control or normal weight group excelled in steadiness, tapping, grip, and endurance. These tests emphasize the physical element as contrasted with the higher mental processes, which may partly explain the superiority of the control group. Nicholls' experiment, then, gives very little support to the idea that underweight children are mentally inferior to those of normal weight.

Nutrition classes were studied by Hunt, Johnson, and Lincoln (**24**) consisting of children more than 7% underweight according to the Burk-Boas Height-Weight-Age tables. A large number of psychological tests were administered. In general, a small advantage in favor of the underweight group was found, although the difference in most cases was not statistically significant. These authors con-

clude that, "aside from extreme cases of malnutrition, of prolonged hunger or starvation which like other pathological states would cause disintegration, we cannot say that malnutrition irrespective of other factors produces or runs hand in hand with mental defectiveness. In many types of mental processes the reactions of the undernourished child are equal or superior to the average of his age group. The traits in which he may prove less capable seem to be resistance to fatigue under response to uninterrupted or complex stimuli, and exaggerated emotional responses under normal stimulation." Again we find that no evidence has been uncovered which would tend to show that underweight children (assumed to be malnourished) are psychologically inferior to those who approximate the norms more closely.

It seems that height and weight as indicators of a state of nutrition have been seriously questioned in recent years. Stalnaker (**41**) in a critical review calls attention to the fact that the definition of "malnourished" and "undernourished" in terms of height and weight is an extension of the term "nourishment" which has not yet been validated. Even assuming that malnutrition has a direct effect upon intellectual capacity, it now seems probable that neither height nor weight constitutes a very promising approach to the problem. If it should be demonstrated, for example, that height and weight are more a function of racial stock than of nutrition, then experiments on malnutrition have really been attempting to show that intelligence is a function of racial stock. On the basis of Garth's (**17**) review of racial intelligence, we would hardly expect a marked positive relationship.

Since rickets involves a disturbance of calcium and phosphorus metabolism, it is reasonable to suppose that there would be mental effects. Peters (**37**) has remarked that there is a very noticeable association of idiocy and rickets, and that "both idiots and rachitics show a want of phosphorus and calcium in the bony system". Gesell (**18**) states that although older writers suggest rickets as a causal factor in producing amentia, there is no foundation for this belief. He concludes, after a review of the situation, that "the retardational effect of rickets is less than is commonly supposed, and is transient in character". The behavior output may be depressed but it seems doubtful that the nervous system is fundamentally altered. Frank (**15**) investigated the learning ability of rachitic white rats. She found that they took fewer trials, made fewer errors, but consumed more time in learning than normal rats. A detrimental effect can hardly be claimed, as the unfavorable time record may have

been a matter of motivation. However, Frank did find normal rats decidedly superior in a relearning test 3 months later, but seemed reluctant to attribute it to the direct influence of rickets. This is a point worthy of further investigation. The experiments indicate, then, a lack of definite evidence that intelligence or learning ability is fundamentally altered by rickets.

The possibility that vitamin B complex may have some influence on intelligence and learning ability has been considered. Maurer and Tsai (**30, 31, 33**) have experimentally investigated this problem by permitting 36 nursing rats to suckle vitamin-B-depleted mothers. This group was compared to a normal group. Maze training was started at 70 days of age and a statistically significant superiority of the normal rats was found. The generalizations of these authors (**32**) have been very severely attacked (**13**), and it is a question as to how freely one may pass from rats to men. Nevertheless, since their work has been verified by Bernhardt (**6**) it must be given serious consideration. The suggestion that the nervous system can be permanently altered through a deficiency of vitamin B complex during the early formative period should stimulate investigation to discover the extent to which this may be occurring in human beings. In this connection the study of Hoefer and Hardy (**20**) may be considered. They found that breast feeding for a period of 4 to 9 months was more favorably associated with intelligence than breast feeding for a greater or shorter period of time. They report that no child artificially fed had an I.Q. as high as 130. The suggestion is made by Maurer and Tsai (**32**) that lack of vitamin B plays a part in this. However, Hoobler, Outhouse, and Macy (**23**) and Macy, Outhouse, Graham, and Long (**28**) find that human milk is often deficient in vitamin B. Moore, Brodie, and Hope (**34**) find the same thing true in the case of the rat, and Dennett (**11**) believes that cow's milk, and in some cases human milk, does not contain the optimal quantity of this vitamin. Is a child with a high I.Q. one of the few fortunate enough to secure adequate vitamin B during the nursing period? Perhaps a plentiful supply of this vitamin is necessary to the full development of hereditary potentialities. Whether or not the I.Q. can be improved by supplying a rich source of vitamin B to lactating human mothers remains to be seen, but it is at least an interesting suggestion. There is also the possibility that an artificial diet need not depress intelligence, assuming that it does, if sufficient vitamin B is furnished.

Fritz (**16**) did not find that the accuracy of maze performance was significantly affected by a vitamin-B-deficient and salt-defective diet. His study does not necessarily conflict with that of Maurer

and Tsai since he used relatively mature rats and they used nursing or highly immature rats. In the one case the structure of the nervous system was complete before the nutritional attack began, but in the other it is highly probable that important developmental changes were in progress.

An interesting finding is that of Balyeat (3, 4) who reports considerably higher I.Q.'s, in 2 different studies, for allergic children than for non-allergic. Sixty-eight per cent of the allergic children ranked in the superior group or above, as compared to 25% of the non-allergic. Balyeat suggests the explanation that the brain cells in those with allergic tendencies are more irritable or hyperactive.

A few investigations have been concerned with the effect of restricted diets. Anderson and Smith (1, 2) fed young rats a diet in which the sole source of protein was gliadin. Such a diet permits rats to maintain body weight but they do not grow. When the gliadin is replaced by casein, the diet becomes adequate. A group of rats on the gliadin diet (qualitatively stunted) and another group fed the casein diet but only enough to maintain body weight (quantitatively stunted) were compared with a control group permitted to eat of the adequate diet without restriction. The experimental groups were found to be superior to the normal in relearning a maze but in a second relearning period, following realimentation, the records tended to become similar. Miles (5), working with a group of 12 men whose body weights had been reduced 10% and held at that level by restricting the intake of food, reports that no evidence was found of lessened ability to do college work while on the restricted diet for a period of 4 months. Holck (21) found that "Fletcherizing" had no significant effect upon sleeping time, mental multiplication, and typewriting speed, but that typewriting accuracy was reduced. He also reports an improvement in efficiency of solving chess problems. A vegetarian diet was found by Tang, Chin, and Tsang (42) to have an unfavorable influence upon the learning of male rats but to have no effect in the case of females. Most vegetarian diets involve a certain degree of restriction, since it is difficult to secure the required number of calories and a liberal supply of protein when foods from animal sources are excluded. Further experiments on quantitative and qualitative restriction would be desirable but the evidence so far indicates no fundamental reduction in learning capacity.

With the possible exception of vitamin B deficiency during the nursing period, the evidence which has accumulated up to the present time must be disappointing to those who believe in a marked effect

of malnutrition upon intelligence and learning capacity. On the other hand, we cannot say that malnutrition occurs without any psychological effects, for the techniques used may not have been adequate. It is possible that with refinements in measuring behavior, particularly in the measurement of animal behavior, definite effects will be uncovered. It is also important to note that even though intelligence may not be fundamentally altered, should the desire to achieve be lowered through lassitude and ill health, we certainly have sufficient argument for giving some attention to the question of nutrition. In other words, we are faced with the familiar psychological problem of capacity *versus* achievement. It may very well be that short time samplings of behavior will show no reduction in capacity, which is fortunate if true, yet at the same time there may be a depression of the total behavior output. Levine (25) presented statistics in 1925 showing that at least 4 million school children were suffering directly from malnutrition. Bliss (8) found in his study that one-fourth to one-third of the children were underweight and therefore assumed to have less than optimal conditions of nutrition. Cramer (9, 10) thinks that many people are in a chronic state of vitamin underfeeding and that a lasting weakness may in this way be carried over from infancy. If the conditions to which these authors refer are in any way a cause of lowered vitality and energy, then we have here an important cause of national inefficiency. It is difficult to believe that the total possible output of an organism has nothing to do with physiological efficiency, for output must be a function of the supply of energy at the disposal of the organism.

Summary

Contrary to what would be generally supposed, there is very little experimental evidence at present to indicate that diet markedly affects intelligence or capacity to learn. The one exception to this generalization is the investigation of Maurer and Tsai, verified by Bernhardt, which needs to be considered seriously since figures are presented indicating a strong probability of statistical reliability. It would seem that a distinction between capacity and achievement has not always been clearly made. An organism may be able to learn but lack the "drive", due to lassitude and ill health which in turn may be a function of diet. Experiments are needed to determine the effect of malnutrition upon the total behavior output. Such experiments need not involve the assumption that the nervous system will be structurally altered through dietary assault.

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WARREN, HOWARD C. (Editor). *Dictionary of Psychology.* Boston: Houghton Mifflin Company, 1934. Pp. x+372.

The main part of the volume consists of definitions of what, from sampling and calculation, would seem to be approximately 8,400 terms. These are words and phrases of a technical sort which the reader will meet with in psychological literature and which the psychologist may wish to use in his writing. Psychology today is so closely related to a number of neighboring fields that terms of psychological interest have been added from the following: neurology, physiology, anatomy, physics, sociology, education, art, folk-lore, religion, psychiatry, industry, mathematics, and logic. The editor has believed that a technical definition should be in the nature of a mathematical equation and, in order to emphasize this point of view, the editor has adopted the form of the word or phrase to be defined followed by the equal sign, which in turn is followed by the definition, or in many cases by alternate definitions.

The last 70 pages of the book contain a number of appendices which vary greatly in content but all of which should be extremely useful to the professional psychologist or the student in psychology. These appendices vary from a list of tests of color vision to a chart of electrical circuit diagrams. Noteworthy among these appendices is one of human reflexes (giving the stimulus, pathway, and response of each), a list of statistical formulæ, topographical reference terms relating to the human body and to the central nervous system, and a glossary of technical terms from French to English and another from German to English.

It seems to the reviewer that the discussion of any individual terms would be useless and a waste of space. The volume is exceedingly complete and the terms well and clearly defined. Such a volume cannot but be a major factor in the stabilizing of psychological terminology. It will be of very great assistance to the student who is reading psychological literature and to the professional psychologist in writing more clearly and more exactly. The magnitude of the volume, its scope, and the variety of points of view of those who have made the definitions enhance greatly its usefulness at the present time as well as its continued usefulness for the future. Undoubtedly

new terms will be added to psychological terminology from time to time. But the attitude of the editor in including all possible terms at the moment will make this book of the greatest value for many years to come.

This dictionary was composed by 112 collaborators under the guidance of an advisory board of 7, but always under the inspiration of Professor Warren as editor. Probably only those who have had an active part in its preparation will realize how much of the labor of finding the terms and of their definition had already been performed by the editor. Each collaborator was a specialist in his field and hence one may consider these definitions authoritative, especially as each definition was checked by a second collaborator. But the volume will always remain a lasting memorial to the energy, vision, and foresight of the editor, Howard C. Warren.

SAMUEL W. FERNBERGER.

University of Pennsylvania.

GOODENOUGH, FLORENCE L. *Developmental Psychology: An Introduction to the Study of Human Behavior.* New York: D. Appleton-Century Co., 1934. Pp. xx+619.

Protean as has been the psychological text, it would be difficult to find a volume that resembles closely Dr. Goodenough's *Developmental Psychology.* The task she apparently envisaged for herself in preparing her opus was that of providing a conspectus for young college students, or those of similar mental ilk, of the course of human psychological development from conception to death—a plan which I believe adumbrates future trends.

Anything but encyclopedic, in spite of its 619 pages, the text devotes itself largely to the exposition of general principles, supporting these with critical material culled largely from the experimental field. Although, to be sure, the student is allowed to feel the broadside of most of the significant psychological controversies, he is spared such unnecessary confusion as results from the amassing of cloying details.

The volume is rather loosely articulated, the author intending apparently to illuminate the terrain selected for survey by longitudinal, horizontal, and perpendicular focussings. The chapter headings reveal clearly this lack of a single coign of vantage as far as time is concerned. The headings are: Psychology: The Study of Human Development, Problems and Methods of Modern Psychology, Our Hereditary Background, Prenatal Development of the Nervous

System and of the Body as a Whole, Growth and Functions of the Sense Organs, The Behavior of the Unborn Child, The Child at Birth, The Period Before Speech: Physical Growth and Motor Development, Emotional Behavior in Infancy, The Social Reactions of Infants, The Development of Color-Vision in Infancy, Early Childhood, The Social and Emotional Behavior of Young Children, General Intelligence and Its Measurement in Early Childhood, The Kindergarten Age, How Older Children Learn, Bright and Dull School Children, Special Abilities and Defects, The Development of Personality and Character in Later Childhood, Adolescence, Educational and Vocational Guidance for the Adolescent, Motivation of Behavior at the College Level, Adult Behavior and Social Customs, The Maturation and Decline of Abilities, Mental Disease, Old Age, A Backward Look. Major psychological concepts are dealt with as a need for an understanding of them arises in the course of the discussion of the problems related to development. The concept of motivation, for example, receives no expanded treatment until the twenty-second chapter, which is entitled, Motivation of Behavior at the College Level; while, surprisingly enough, space is devoted to introversion-extroversion in the chapter on The Kindergarten Age.

The work shows the effect of the author's preoccupation with the preschool field, for only 270 of the 619 pages of the text are devoted to the problems of the years beyond six. The assignment of a whole chapter to the question of color-vision is an emphasis revealing another of the author's special interests.

As far as its basic alignments are concerned, the text can scarcely be said to be congeneric with any of the more or less polar psychological systems, a discriminating eclecticism, rather, being characteristic of it.

Valuing the work as I do, my inclination is to eschew the task of discussing aspects of the presentation with which I personally cannot concur. Since, however, this responsibility of the reviewer is one generally held to be of importance, I shall offer the usual challenges and hope thereby to stimulate the reader to expose himself to the volume.

Although as was indicated earlier, the author is writing an elementary text,—a project favorable to what appear to be ex-cathedra pronouncements because of the necessity for simplification and fractionation—, she seldom sketches issues that are debatable without suggesting that they are Janus-faced. In a few instances, however, I find myself challenging the putative fact or having my sensitivities

jarred by the unequivocalness implied in the view of the case given. As an example of a fact I would question is the following: "The middle ear is filled with a salty fluid, and this fluid is set in vibration by the vibration of the ossicles" (p. 100).

With evidence accumulating to suggest that in embryonic development the mesoderm has a basic organizing function, I find myself somewhat uneasy when I read the statement: "The growth and differentiation of nerve and muscle proceed simultaneously, but the neural growth keeps safely in advance of the muscle growth" (p. 119). Similarly I am uncomfortable because of studies such as those of Rogoff, regarding any description of the rôle of the adrenals in emotion, such as the following: "Now under the influence of strong emotions, particularly fear or rage, the adrenal glands are stimulated to increased activity, more adrenin is poured into the blood, and the effect of this increased supply upon the body is marked and widespread" (p. 148).

Though I know the author sees the depths she dares not plumb with the public she is initiating to the psychological sea, to me there seems to be real danger in such efforts at simplification as the following: "What we feel is not the needle but the response of the *sense organ* [italics mine] to the needle" (p. 88). Were one to ignore the epistemological issues at stake, he would still be justified in wondering whether many college sophomores would escape the peculiar biological doctrine of localization of function that is implied. Since the concept of localization of function in the case of the nervous system is one that has been pitifully fogged, I hate to see so little done to clarify it.

As a last illustration of what I believe is a statement of questionable sweep is this, which sounds strangely like the early Freudian abacadabra: "If we know what our motives are, if we bring them out into the open where their conflict can be seen, it will sooner or later be brought to a close" (p. 518).

As a textbook the Goodenough volume has certain rather unique features. The preface, for instance, is addressed to the student. It encourages him to keep an active mind set, to challenge always what he reads. It expounds to him techniques to be employed to the end of stimulating in him the advocated attitudes—techniques such as presenting a series of thought-provoking questions at the beginning of each chapter.

Adapted in style as well as content to the public addressed, Miss Goodenough's writing is vivid, almost chatty, and fast tempoed, a

refreshing humor sparkling through it. I am sure college students will enjoy the text as well as be well guided by it.

HELEN LOIS KOCH.

University of Chicago.

DORCUS, R. M., and SHAFFER, G. W. *Textbook of Abnormal Psychology.* Baltimore: Williams & Wilkins, 1934. Pp. xiii+389.

By avoiding specious hypotheses and topographical analogies the authors have presented as solid and exhaustive a work as has been written in this field. The conventional topics are covered without resort to unique classificatory schemata but, at the same time, with a healthy scepticism for the value of the rigid psychiatric conventions. A high standard of exact nomenclature is maintained. The principal theories relevant to each topic are presented in a fashion enabling comparison of one with another and, perhaps more important, with available experimental data which is exhaustively summarized. This experimental viewpoint should make the book a good basic text. Systematic psychology rarely intrudes, but where it is required for purposes of organization or criticism, the position of Dunlap's "scientific psychology" is adopted.

It must be noted, however, that although Dorcus and Shaffer maintain an impartial and scientific attitude in handling concrete facts and theories, they indicate in the organization of their material a definite sympathy with the structural or descriptive school of psychopathology as opposed to the dynamic. Emphasis is laid on physiological origins and objectively determined descriptions of mental disorders, while the psychological antecedents of these disturbances are dealt with briefly. If, as is so frequently claimed, the purpose of studying abnormal psychology is to throw light on normal psychological processes, it would seem important to dwell more with the processes which are distorted and less with the measurable symptoms of this distortion. From this point of view symptoms would be of significance to the psychologist only insofar as they revealed basic psychological (or behavioral) laws and would not be described for their own sake alone. Dorcus and Shaffer have by no means neglected the dynamic aspects of mental disease, but their attempt to maintain as close a bond as possible with experimental data has led to emphasis on description and, possibly, undue caution in the presentation of psychological explanations.

The section on disorders of speech is particularly good; not only

are contemporary theories summarized clearly but the authors include an original critique of these theories which clarifies the issues very well. Sleep and hypnosis are both dealt with more completely than in any other text, with the possible exception of McDougall's, and if the section on dreams rings hollowly it is probably because the psychoanalytic theories are discussed in connection with association mechanisms rather than with dreams. It is pointed out that "since psychoanalysis has been in vogue, few psychological studies of dreams have been made". One wonders why.

Perhaps the most significant contribution is the final chapter on psychotherapy. Such problems as the nature of the psychological principles involved in catharsis, methods of desensitization and reëducation, and the relation of psychoanalysis to other therapeutic techniques are described in detail and the aims of psychotherapy are concretely illustrated. This chapter is concerned with the methods currently used for the cure of mental disease; it is not diluted with precepts for mental hygiene as are so many textbook chapters on this subject.

ROBERT R. SEARS.

University of Illinois.

KIRKPATRICK, EDWIN A. *Mental Hygiene for Effective Living.* New York: D. Appleton-Century Company, 1934. Pp. xiii+387.

The purpose of this volume is ". . . to present the characteristics of normal functioning, and to show how variations from the normal are produced" (pp. v–vi). It is an attempt to bring together in non-technical terms material from related fields of psychology, sociology, education, and physiology, ". . . to temper them with common sense, and to organize them in such a way as to be helpful to all persons interested in social and individual mental hygiene . . ." (p. v).

With this stated purpose in mind the specialist may excuse the complete absence of quantitative material, the dearth of references to specific, experimental studies related to the subject matter discussed, the oversight of the periodical literature in mental hygiene, and the failure to organize the included material around a permeating core of fundamental psychological and psychiatric explanatory principles.

A sizable portion of the manuscript is devoted to the important concepts, adjustment and normality. Among these chapters are "Mental Health and the Problem of Adjustment", "Combinations of Factors Favoring Normal Adjustments", and "Mental Health

Norms". The Freudian viewpoint is critically treated; a chapter is devoted to "The Schools and Mental Hygiene" and one to "Social Mental Hygiene and Modern Life". As might be expected from previous writings of the author, the chapters on development as related to adjustment are quite good.

For those holding the conviction that mental hygiene principles can be most effectively applied in solving and avoiding problems which arise in normal lives, the chapters "Promoting Healthful Adjustments to Conventions" and "Diagnosis and Correction of Maladjustments" will be most valuable. Psychological and educational counselors, as well as the general reader who is acquainted with modern techniques of personality analysis, will find the section on diagnosis general and probably not immediately helpful. The discussion of special maladjustments and their treatment deals with fears, worries, compulsions, obsessions, and jealousy. One conjectures as to why other maladjustments, such as self-consciousness, negativism, timidity, lying, feelings of inferiority, guilt and futility, etc., are not also included. The conditioned reflex is the only aspect of learnng which is greatly emphasized. Human motives and desires are discussed generally but are not conspicuously linked with adjustment. The book lacks that unity and synthesis which might have been gained by developing the more fundamental psychological and psychiatric concepts as an explanatory background.

This work is, however, a definite contribution to the field of mental hygiene. Teachers, students, and some professional people will find the principles, case studies, and bibliography of practical worth.

FRED MCKINNEY.

University of Missouri.

HENNING, H. *Psychologie der Gegenwart.* Leipzig: Alfred Kroner, 1932. Pp. xi+211.

In this revised edition of an earlier work which appeared in 1925, the author gives a bird's-eye view of the subject-matter of psychology in its historical aspects. The account is no mere recital of unrelated historical facts. Significant trends are stressed and the inter-relatedness between different fields of psychological investigation emphasized. Every student, the author holds, should be acquainted with the increasing number of discoveries in experimental psychology; yet experiment is not the final word. Its function is both confirma-

tory and propaedeutic in relation to theory. The realm of psychological theory is exceedingly diverse, and no clearer illustration of the fusion between the natural sciences and the *Geisteswissenschaften* can be cited than in the field of characterology.

No specialized branch of psychology is neglected in this survey. The first chapter traces the growth of experimental psychology with its foundations imbedded in the empiricism of the associationists, in Fechner's extension of Weber's investigations, in the physiological discoveries of Johannes Müller, Charles Bell and the later work of Helmholtz, and in the problems of reaction times with their genesis in astronomy. All this work was ready to be welded into a system by Wundt. The higher thought processes then succumbed to the experimental method and reference is made to the growth of the various schools of psychology after the turn of this century.

The second chapter gives an excellent survey of the many fields of applied psychology, each one described in its historical setting. Folk-psychology is discussed in relation to Wundt's system, the experimental field, and present day trends and literature. Legal and criminal psychology, the psychology of speech, and that of graphology are next treated. Then follows a survey of the psychology of value and of applied psychology, of the psychology of art, aesthetics, religion, morals, and occult phenomena. Psychopathology and psychoanalysis are discussed at length with emphasis upon infantile sexuality, complexes, and the Freudian concepts. A special section is devoted to geopsychology, which outlines the effects of climatic and seasonal changes upon man's mental life. Then comes a treatment of mathematical psychology, of differential and individual psychology, social psychology, the vaguely defined "Kulturpsychologie", the large field of medical psychology, animal psychology with an emphasis upon experimental results, and of child and educational psychology. The last two sections of this chapter deal with the claims of Krueger's school of "developmental psychology", and the psychology that, derived from the associationism of Hume, furnishes material for a psychological analysis and criticism of philosophic concepts and, in the hands of Erdmann, serves as a foundation for the study of logic.

Chapters three and four deal with imagery in children, type psychology, the dynamics of the unconscious, the nature of intelligence, and the status of characterology. A comprehensive catalogue of the leading psychological journals in Germany, France, Italy, Holland, Belgium, England, and America is added, followed by a bibliography

of publications and textbooks classified according to the subject matter covered by the book.

P. S. DEQ. CABOT.

Harvard University.

HAMMOND, W. A. *A Bibliography of Aesthetics and of the Philosophy of the Fine Arts from 1900 to 1932.* (Revised Edition.) New York: Longmans, Green & Company, 1934. Pp. x+205.

By those interested in the philosophy of the fine arts and in 'aesthetics as viewed by the philosopher', the 1934 revised edition of the bibliography compiled by W. A. Hammond for the American Philosophical Society and the American Council of Learned Societies should be gratefully received. The author does not claim to be offering an exhaustive index to the literature. ("Works on the history or criticism of art, although they may be important in themselves and valuable as writings ancillary to the study of aesthetics, are not included unless, in some respect or other, they are concerned with theoretical problems.") The references are not confined to the date span of the title but include "some old and valuable works republished since that date [1900]".

An examination of the contents reveals chapters on reference works, systematic and general works, history of aesthetic theories, painting and the graphic arts, sculpture, architecture, civic art, poetry and the aesthetics of literature, music (about 180 references), color (about 70 references), design and decorative art, style, origins of art and primitive art, symbolism, art and morality, art and religion, and art and psychology. This last section contains about 180 references listed as general, 25 on empathy, and 60 on laughter, caricature, and the comic.

Professor Hammond's professed view that "we must look to psychological experiment, to controlled introspection, and to the scientific study of art objects for the solution of the central problems of aesthetics, if they are at all soluble" does not appear to be reflected in his bibliography. Although he has included a few titles from experimental aesthetics and acknowledges indebtedness to Professor A. R. Chandler for permission to incorporate a number of titles drawn from the latter's *A Bibliography of Experimental Aesthetics 1865–1932,* his references in this field contain few of those starred in the Chandler list. The periodical list in the front of the Hammond volume does not even include the Journal of General Psychology,

Journal of Genetic Psychology, Genetic Psychology Monographs, Psychological Monographs, Journal of Comparative Psychology, or the Journal of Applied Psychology, although Hammond does list references to articles which have appeared in the last three. No doubt Professor Hammond had logical reasons for his selections from the experimental literature, but the reviewer could not discover them. It would seem that as the Hammond and the Chandler lists overlap so little, the philosopher and the experimentalist need them both.

PAUL R. FARNSWORTH.

Stanford University.

CHANT, SPERRIN N. F. *Mental Training—A Practical Psychology.* New York: The Macmillan Company, 1934. Pp. x+195.

To meet the need of those persons studying psychology with the expectation that it will prove helpful for understanding and improving their own mental lives, the author has developed this small, readable, and useful volume. It was his aim to make this material scientific as well as practical, and he has achieved this by presenting principles evolved from experimental data which have developed in his classes in experimental psychology. Tables and curves, however, are made palatable even to the layman by showing application of the findings to numerous daily experiences.

Simple, clear presentations of both the scientific and practical points of view precede chapters on habits, learning to remember, to attend, to reason, and to make decisions, and a final valuable survey of mental health precepts. An itemized summary at the end of each chapter puts the material in a form available for daily applications.

The difficulty always encountered in preparing laboratory findings for lay consumption, that of condensing the many qualifications and viewpoints into simple language which can be comprehended with facility, has been met very well in this book. There are a few cases in which certain findings that are not borne out by all investigators are mentioned unqualifiedly; among these are the superiority of the whole method in memory, the perseveration phenomenon as an explanation for fixation in learning, and the view that recall is the only valuable criterion of memory.

The reviewer conjectures as to the basis for the exclusion of some related material of a practicable nature, for example, factors in efficiency such as illumination, temperature, rest periods, and drugs, and material on improving reading ability. The author's style of

writing and the present size of the book would have well allowed additional material.

FRED MCKINNEY.

University of Missouri.

SMITH, T. V. *Beyond Conscience.* New York: McGraw-Hill Book Company, 1934. Pp. xv+373.

This volume deals with conscience as a philosophical, not a psychological, problem. The author calls the roll of various forms of implementation—that is, arguments (theological, idealistic, sociological, metaphysical, logical, etc.) for the authority of conscience in the field of moral behavior. He is not concerned with conscience as a type of individually performed behavior engendered under social-psychological, sociological, and anthropological auspices. Nevertheless, there is considerable material here for the social psychologist interested in studying ideas and attitudes about conscience.

J. R. KANTOR.

Indiana University.

BOOKS RECEIVED

BANISTER, H., *Psychology and Health.* New York: The Macmillan Company, 1935. Pp. viii+256.

EARLE, F. M., and KILGOUR, J., *Studies in Vocational Guidance: V. A Vocational Guidance Research in Fife.* London: The National Institute of Industrial Psychology, 1935. Pp. 101.

FITE, WARNER, *The Platonic Legend.* New York: Charles Scribner's Sons, 1934. Pp. viii+331.

GEMELLI, AGOSTINO, and PASTORI, GIUSEPPINA, *L'Analisi Elettroacustica Del Linguaggio: I. Testo.* Pubblicazioni Della Università Cattolica Del Sacro Cuore. Serie Sesta: Scienze Biologiche. Vol. VII. Milano: Società Editrice "Vita e Pensiero", 1934. Pp. xxviii+250.

GEMELLI, AGOSTINO, and PASTORI, GIUSEPPINA, *L'Analisi Elettroacustica Del Linguaggio: II. Atlante Delle Tavole.* Pubblicazioni Della Università Cattolica Del Sacro Cuore. Serie Sesta: Scienze Biologiche. Vol. VII. Milano: Società Editrice "Vita e Pensiero", 1934. Pp. lxxxviii.

JAHNSEN, THORLEIF, *Heart and Spirit.* Oslo: Cammermeyers Boghandel, 1934. Pp. 278.

MALAMUD, WILLIAM, *Outlines of General Psychopathology.* New York: W. W. Norton & Company, Inc., 1935. Pp. xiv+462.

SEASHORE, CARL E., and SEASHORE, R. H., *Elementary Experiments in Psychology.* New York: Henry Holt and Company, 1935. Pp. vii+219.

Studies in the History of Ideas, Vol. III. (Edited by the Department of Philosophy of Columbia University.) New York: Columbia University Press, 1935. Pp. 511.

NOTES AND NEWS

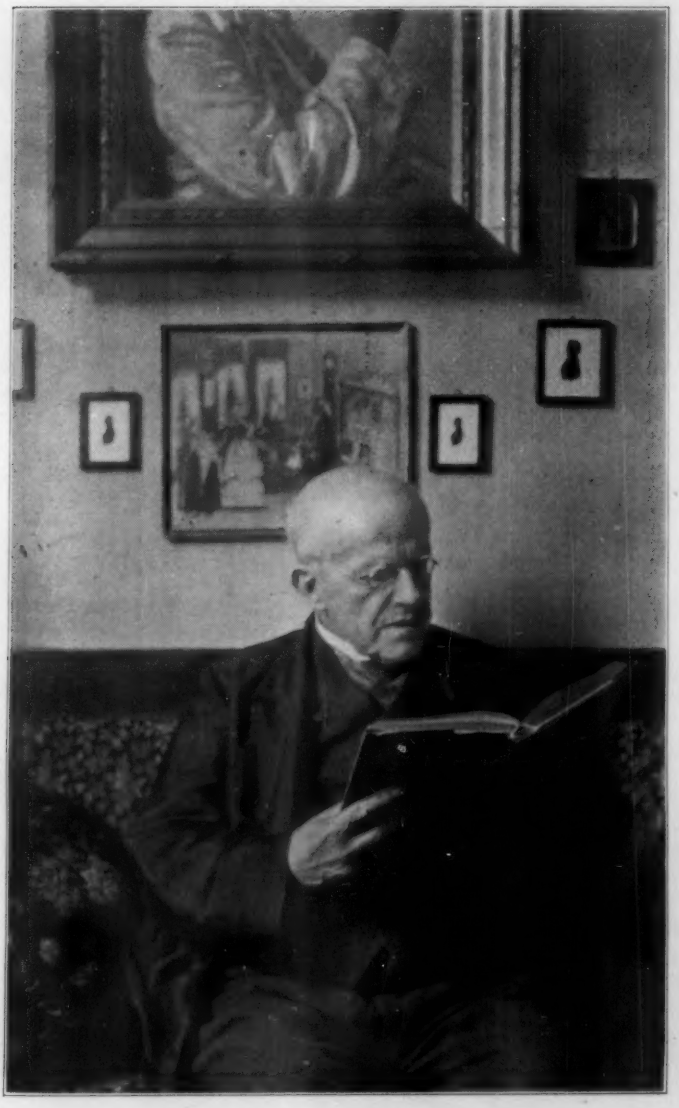
PROFESSOR KARL S. LASHLEY, now at the University of Chicago, has accepted an appointment as Professor of Psychology at Harvard University.

PROFESSOR GEORGE D. STODDARD, director of the Iowa Child Welfare Research Station, University of Iowa, has accepted an appointment at Teachers College, Columbia University, during the six weeks' summer session. He will offer courses in child and adolescent psychology.

THE WESTERN PSYCHOLOGICAL ASSOCIATION will hold its annual meeting at the University of California at Los Angeles, June 28 and 29, 1935. The Association is participating in the program of the annual meeting of the Pacific Division of the A.A.A.S.

PROFESSOR WOLFGANG KÖHLER, director of the Psychological Laboratory at the University of Berlin and lately of Harvard University, has been appointed visiting lecturer for both summer sessions at the University of Iowa, beginning June 10, 1935. He will offer courses in advanced general psychology, the psychology of learning, and physiological psychology.

PROFESSOR WILHELM STERN of Hamburg has been appointed to a visiting professorship at Duke University, Durham, North Carolina, for this year, instead of at the University of North Carolina at Chapel Hill, as announced in the April BULLETIN.



Georg Elias Müller (1850–1934)